Chemistry/Biology 302-01 -- Biochemistry **Fall 2001**

Peter Kuhlman

Welcome to Biochemistry! This syllabus should help you prepare yourself for what I hope will be an exciting and challenging exploration of the chemistry that underlies life as we know it on earth.

What I want to achieve in this course this semester:

- What we term "biochemistry" includes a huge -- HUGE -- realm of knowledge. I expressly do NOT hope to teach you all of it. Rather, I hope to introduce you to a selection of topics in biochemistry, with the intent that by mastering these topics, you will be prepared to master other domains of biochemistry as well.
- My main "content" goal for this course is to guide you to a deep-seated understanding of the relationships between molecular structure and biological function for the major classes of biological macromolecules. By the end of this course, you should have begun to develop the ability to predict the change in function that might accompany a particular change in structure of a molecule that you have never seen before. To approach this goal, I intend to introduce you to lots of examples of biologically-important macromolecules, with many of these 'molecular case studies' drawn from the primary research literature.
- My main "process" goal for this course is to motivate your desire for more sophisticated ways of thinking about biochemical data and biochemical systems. This objective will also lead us into the research literature, and involve the use of 'professional-grade' molecular modeling tools. Indeed, this goal underlies much of the format of this course, and is the greatest goal (in my opinion) that any educator can strive for. I hope that we can achieve it together.

Who I am and how to get in touch with me:

Instructor: Peter Kuhlman
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Office hours: I have become dissatisfied with regular Office Hours. It seems that neither of us are well-served if my choice of Office Hours doesn't match your schedule -- you don't get your questions answered and I sit there alone in my office. Instead, I will hold a regular review session *every other Tuesday evening from 6:00 pm until 8:00 pm* throughout the semester (on even-numbered weeks -- the second, fourth, sixth, etc), and I will meet with you at other times of your choosing outside of class hours. I will make every effort to ensure that you and I can find a time to meet and discuss any topics that are of concern to you. *I will be available for at least 4 hours of appointments each week,* scheduled by the end of the preceding week.

Course material:

Text: *Biochemistry, Fourth Edition*, Zubay (1998).

Supplement: In class, I make extensive use of illustrations from your text and other sources. In order to allow you to view, copy, and annotate these illustrations, I plan to make most of them available to you online. You may access these illustrations and other class resources by pointing your web browser to http://www.denison.edu/~kuhlman/courses/ and looking for class links listed under the heading "Biochemistry".

It is one of my personal goals for this fall to develop these online resources more fully in the hopes that they will be a real benefit to your learning. Please be patient with me, and please let me know if you ever have problems accessing these materials!

How we'll achieve the course goals:

It is my experience that the best way to learn is to *read, think, and discuss*. Because I intend to help you *think* biochemistry and *learn* biochemistry together with your classmates, I will structure many of our class meetings differently than a conventional lecture. And because it is my fundamental assumption that I am here as your *partner* in learning, I invite you to join me in taking responsibility for your education. For instance, I expect that you, as an experienced student at Denison, have learned to read textbooks in a sophisticated fashion, and I will therefore NOT routinely re-cover the material in your readings from the text. Rather, I expect you to come to class each day prepared to actively engage the material. Thus I will be disappointed if you have not spent enough time outside of class with your text and notes in order to understand and be able to contribute to the class conversation. To help focus your reading and thinking, I will often provide comments and questions to accompany the recommended passages from the text.

I will structure our class time in ways intended to help you review, reinforce, and synthesize the material in the text. I will do some lecturing, we will do some (both large and small) group discussions, and I will at times ask probing questions. There will be opportunities over the course of the term for you to practice making observations and reaching conclusions on the basis of those observations. And there will be many times when I will ask you to make predictions of the behavior of biochemical systems on the basis of what you have already learned. Throughout, I will be looking more for evidence that you are trying to learn and to think than for evidence that you have the "right" answers. I will ask questions *not* to be cruel or "tough", but rather because I believe it is my job to help you *learn to learn* and *learn to think critically*. That said, please note that although I will endeavor to structure this class to maximize your benefit from it, I recognize that I am fallible (!) and that we don't all learn in the same ways, so I strongly encourage you to share your feelings about the class with me as we go along!

This class format is most effective when every member of the class is engaged. If class members either dominate, distract from, or withdraw from the class, we are all likely to learn less. Given our large class size, this will be a special challenge this semester. I will therefore base part of your grade on my evaluation of your contribution to the class discourse. That doesn't mean that you should feel compelled to say a lot in class, or that every comment or answer you give has to be "right". On the contrary, we often learn much more from our mistaken answers than from our correct ones. Accordingly, I will note only whether your comments and answers indicate (a) that you are coming to class prepared and (b) that you are thinking. Of course, this also means that you must generally be present in class (and you must arrive on time), for if you aren't there, it will be difficult for you to contribute to the class and to show me that you're reading and thinking.

More specifically, if you *must* be absent from any laboratory or exam day, please see me beforehand if at all possible, and in any case be prepared to rigorously justify your absence (with supporting documentation from, for example, Student Health or the Academic Support office). Absence on a test date will result in a score of zero for that test if you have not *previously* made an arrangement with me to take the test at another time. You are responsible for all class material whether you are present at all class meetings or not, so be sure to make arrangements with me and with your classmates to obtain the information that we covered in class on any days that you are not present.

In order to extend your classroom learning experiences, to give you exposure to useful tools and techniques, and to give you a sense for what sorts of questions I am apt to put on the tests before you sit down to take them, I will occasionally recommend problems from the textbook or give you challenge questions. In addition, I have compiled a long list of questions to stimulate your studying and reflecting. These are available online.

I will strive to keep the format and content of this class flexible so that I can respond to your needs and interests as we go through the semester. Consequently, you should view the course calendar and even the grading scheme as approximations of the final outcomes at the end of the course. I agree with past students that this flexibility enhances my ability to make this Biochemistry course *your* Biochemistry course. I also realize, however, that this very flexibility can be unsettling, and I will therefore also

strive to make it very clear what my view of the class structure and priorities are. Furthermore, in order to make changes to the course on the fly, we need to be in ready communication, and so I ask that you make it a habit to check your e-mail *daily* in case we need to be in touch about class-related matters.

Finally, I think that it is important for you to learn how to decide which of the many, many bits of information that you encounter in this class are more important and which are less important. Similarly, I want to encourage you to reflect on which aspects of the material ***I*** think are important and am apt to stress on exams. To stimulate these kinds of higher-order learning, I'll give you one extra point for every exam question that you predict I will ask. Of course, I don't expect you to come up with the exact questions, but with some work I think that you'll be able to predict the types of questions I'll ask. I will accept up to four of these sample questions for each exam. In order to receive credit for your submissions, you must send me *sample questions and correct answers in plain (unformatted) text by email before the test is administered*. I'll tell you more about this in class.

Laboratory participation:

The laboratory component of this course is an integral part of it. This is reflected in its large numerical weight in the overall grade scheme of the course. To pass this course, you MUST complete all assigned laboratory work. Period. You will receive the laboratory manual on your first day of lab (meet in room 201 the first day).

Special Needs

Different students come to this class with different training, different backgrounds, and different abilities. If you feel that because of personal factors you would benefit from some modification of course procedures, such as special test-taking arrangements, I ask that you contact me privately *at your earliest convenience*. I will work with you and with the Academic Support staff (Doane Hall, room 104) to optimize your learning experience. Certain accommodations will require verification of disability based on documentation on file in the Academic Support office.

How will your learning be assessed?

As I currently envision the course (and subject to feedback from you), there will be eight opportunities (in addition to class discussions) for you to demonstrate to me your mastery of biochemical concepts -- six in-class tests, the laboratory exercises, and a final exam:

laboratory	350 (details in lab manual)
class participation	100
hour-long tests	5 x 80 = 400 (6 tests; best 5 count toward final grade)
final exam	150
TOTAL	1000

I will not downgrade you based on a “curve”. Thus all of you could get "A"s (and I would be tickled pink if you did!). However, if you all do poorly in the course, and if I conclude that it is because I did something wrong, I will adjust all grades upward from the following distribution. Thus, you may regard this as the harshest scale I will apply:

870 - 1000 points	flavors of A
760 - 869	flavors of B
650 - 759	flavors of C
500 - 649	flavors of D
Less than 500	F

· Finally, I wish to make clear my interpretation of letter grades.
I view an "F" as a strong condemnation of the effort and commitment put forth by a student. I hope not to give your class any "F"s.
I view a "D" as an indication that a student is performing well below my standards and well below the student’s abilities. I hope not to give your class any "D"s.

I view a "C" as notice that the student is present but not fully motivated or engaged. A "C" student is doing adequately but has not committed the personal resources to the class to effectively learn.
I view a "B" as a very respectable grade. The student to whom I give a "B" may be trying very hard but still struggling with mastery of the material, or may be working less hard and stopping short of achieving excellence.
I view a "B+" as an indication that a student is doing a good job. This grade indicates to me that the student is expending significant care and effort to ensure that s/he is learning the material.
I view an "A-" as a very good grade. I do not give this grade lightly or without evidence that a student is truly approaching mastery of the material, for this grade indicates that a student has met my expectations for the course.
I view an "A" as an indication of true excellence. In order to achieve an "A" in my course, a student must demonstrate to me that s/he has not only committed the necessary resources to master the material, but also that s/he is *aggressively engaging the questions that we explore*. This is a grade to be proud of, a grade to be earned by serious work and mental sharpness.

Tentative schedule for Biochemistry 302-01

Exact readings and other exercises will be determined on the basis of the progress of the class as a whole and will be given out in class. This schedule is designed to give you a sense of where we'll be going this semester and how the classroom and laboratory exercises will fit together.

Part One: The Basics

Week 1
Getting excited and getting acquainted with where we are going
Biochemical unity and diversity -- the tree of life
The cellular environment
(*read Zubay chapter 1; review the list of base topics and remind yourself about these concepts and techniques; test your level of understanding on practice problems)*
LAB1 The Big Picture, Check-in, Review making measurements, Make buffers

Weeks 2 and 3
The milieu of life – water and pH (*Zubay chapter 3*)
The building blocks of life -- nucleotides, sugars, lipids, amino acids
(*read Zubay chapters 13 and 19, the first five pages of chapter 4, and your notes from Molecular Biology; memorize the structures and properties of the 20 amino acids commonly found in proteins*)
LAB2 Protein standard curve, Pour gel filtration column
LAB3 Lysate prep, Cation exchange
Sept. 14 test #1

Weeks 4 and 5
Scaling up: from amino acids to proteins...issues of protein folding and structure (*Zubay chapters 4& 5)*
LAB4 Dialysis, clinic on construction of purification table and scientific writing
LAB5 Sample concentration, Standardize gel filtration column

Week 6
Metabolism overview -- how the biochemical building blocks are related by the process of enzymatic action. So how do we study enzymes?…
Molecular biological techniques in biochemistry (*for additional reading, see Zubay chapter 32*)
Protein purification and characterization (*Zubay chapter 7*)
LAB6 Gel filtration of sample, plan SDS-PAGE dilutions
Oct. 03 test #2
Interactions of proteins with small molecules and with other proteins

Part Two: Towards a predictive understanding of biochemical structure/function relationships

Weeks 7 and 8

Reinforcing the lessons of protein biochemistry through the detailed examination of several proteins (*sections of Zubay chapter 6*)

LAB7 SDS-PAGE part I, Redox of sample

*** Fall study break ***

Oct. 17 test #3

LAB8 SDS-PAGE part II

Weeks 8, 9, and 10

Catalysis, thermodynamics, and kinetics (*Zubay chapters 2, 8*)

Molecular mechanisms of protein function, as evaluated with the aid of kinetics (*Zubay chapter 9)*

LAB9 Overview of Experiment #2

LAB10 Optimal pH and K_M determination

Oct. 31 test #4

Weeks 10, 11, and 12

Control of protein function by direct and indirect modification (*Zubay chapters 10 and 11*)

Protein design and "custom" enzymes -- predictive structure/function analysis

LAB11 Inhibitors

LAB12 Buffer alteration study

Nov. 14 test #5

Part Three: Protein structure/function relationships in their native environment: Metabolic Biochemistry

Weeks 13, 14, and 15

Bringing it all together -- a detailed examination of core energy metabolism (*review your notes from Molecular Biology, read Zubay chapters 12, 14, 15, and 16*)

No LAB in week 13

*** Thanksgiving Break ***

LAB14 Alternative inhibitor study

Nov. 30 test #6

LAB15 Clean-up and Check-out; Poster presentations (*all posters up all week*)